

AC0221 Annex 2

Current N Fertiliser Practice

Summary

All data described in Annex 2 was collected by the British Survey of Fertiliser Practice (BSFP). Part of the dataset has been published in the BSFP (e.g. Defra, 2009) and part of the dataset is unpublished. Across all tillage crops in England and Wales, overall N application rates rose steadily from around 90 kg N/ha in the early 1970s to over 160 kg N/ha by 1985. Since 1985, the overall N rate for oilseed rape has fallen from around 270 kg N/ha to 190 kg N/ha, but N application rates to winter wheat, winter barley and spring barley have not changed aside from small fluctuations. This is despite significant increases in the yield potential of both wheat and barley over this period.

Between 2006 and 2008, for all four of these major crops, the majority of fertiliser N (55% to 67%) was applied as ammonium nitrate. Other major N sources were urea and urea ammonium nitrate, although the relative importance of these varied with crop species.

For winter wheat, 25% of the total N was applied in March, 46% in April and 23% in May. For winter oilseed rape, 11% of the total N was applied in February, 44% in March and 36% in April. For winter barley, 40% of the total N was applied in March and 47% in April. For spring barley, 28% of the total N was applied in March, 51% in April and 16% in May.

Autumn applications were most common for oilseed rape, with negligible amounts for the other crops. Even for oilseed rape autumn applications have become less common over the last 25 years, dropping from over 80% in 1985 to 29% between 2006 to 2008. Winter wheat received the highest average number of nitrogen applications, at 2.66, with 50% of the wheat area receiving 3 applications. The most common number of N applications to winter oilseed rape, winter barley and spring barley was two.

For winter wheat crops receiving three N splits the final split had been applied by the end of March on 4% of fields, by the end of April on 38% of fields and by the end of May on 93% of fields. For oilseed rape crops receiving two splits the final split had been applied by the end of March on 26% of fields and by the end of April on 96% of fields. For winter barley crops receiving two splits the final split had been applied by the end of March on 11% of fields and by the end of April on 86% of fields. For spring barley crops receiving two splits the final split had been applied by the end of March on 9% of fields, by the end of April on 61% of fields and by the end of May on 96% of fields.

Table 1 Average N application rates, numbers of N applications and most common timings for applications for the major arable crops in England from 2006-2008.

	Winter wheat	Winter barley	Spring barley	Winter oilseed rape
Overall N application rate (kg N/ha)	190	138	105	194
Mean number of applications	2.66	1.96	1.56	2.55
Most common timings for applications (% N applied in month)	Mar (25%) Apr (46%) May (23%)	Mar (40%) Apr (47%) May (8%)	Mar (28%) Apr (51%) May (16%)	Feb (11%) Mar (44%) Apr (36%)
Percentage of fields receiving all N by the end of March, April or May for wheat receiving 3 N splits and other crops receiving 2 splits.	Mar (4%) Apr (38%) May (93%)	Mar (11%) Apr (86%) May (99%)	Mar (9%) Apr (61%) May (96%)	Mar (26%) Apr (96%) May (100%)

Long-term trends in total N rates

Across all tillage crops in England and Wales, overall N application rates rose steadily from around 90 kg N/ha in the early 1970s to over 160 kg N/ha by 1985 (Figure 1). This rise can be partly explained by a major reduction in the spring barley area and a corresponding rise in winter wheat area. Due to its longer growing season, higher yield and higher grain N concentration, winter wheat has a higher N requirement than spring barley. It is likely that improvements in lodging resistance through the development of shorter varieties and the greater use of PGRs, together with the greater yield potential of new varieties, caused N rates to increase. There may also have been a reduction in the use of manure and slurry over this period, which could have contributed to the use of higher rates of manufactured N, although data on manure use before 2002 is not available from the BSFP. Since 1985, overall N application rates to tillage crops have on average remained largely unchanged, showing only a very slow fall to around 150 kg N/ha in recent years.

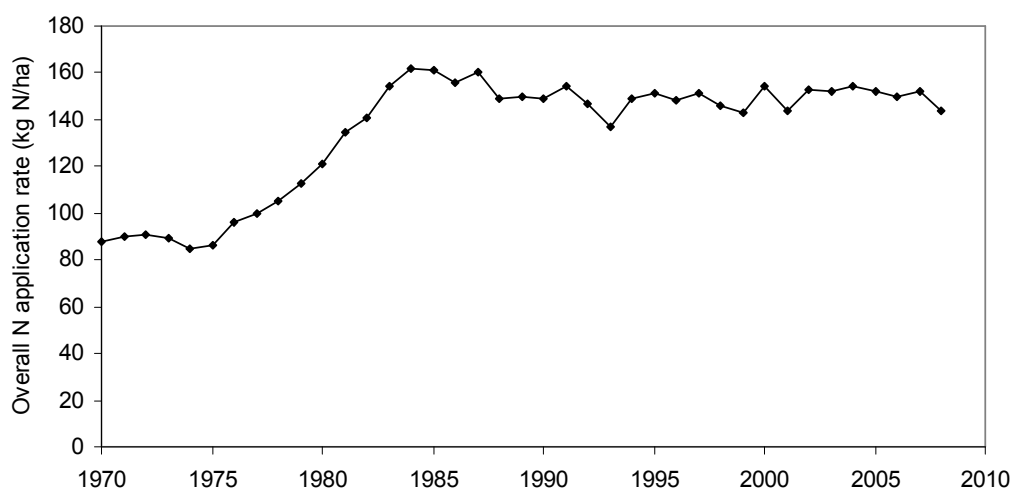


Figure 1 Overall N application rate (kg N/ha) to tillage crops in England and Wales from 1970 to 2008 (data from Defra, 2009).

Data on N rates to specific crops show that this slight fall since the mid-1980s is almost entirely due to falls in N application rates to oilseed rape. The overall N rate for oilseed rape fell from around 270 kg N/ha in 1985 to between 180 and 200 kg N/ha from 1992 to the present. N application rates to winter wheat, winter barley and spring barley have not changed in the last 25 years, aside from small fluctuations probably related to seed and fertiliser prices and weather conditions (Defra, 2009). This is despite increases in the yield potential of both wheat and barley over this period. Since 1980, the average UK wheat yield has increased by around 2 t/ha, and the barley yield by 1.5 t/ha (Defra, 2010).

In England and Wales, overall average N application rates for the harvest years 2006-2008 were 190 kg N/ha for winter wheat, 138 kg N/ha for winter barley, 105 kg N/ha for spring barley and 194 kg N/ha for winter oilseed rape (Defra, 2009).

N source by product

For each of the major arable crops, 55% to 67% of fertiliser nitrogen is applied as ammonium nitrate (Table 2). Urea accounts for 8% to 18% and Urea Ammonium Nitrate (UAN) accounts for 10% to 17%. Other sources of N fertiliser include Calcium Ammonium Nitrate (CAN) and compound fertilisers which include other nutrients as well as N. Spring barley receives proportionately more N as compound fertiliser. Organic manure is applied to between 10% and 25% of the area of these major crops (Table 3). The reduction in N fertiliser on the areas of crop treated with manure ranges from 7 to 26 kg N/ha (Table 3).

Table 2 Percentage of manufactured N from different types of fertiliser, for major arable crops. All data is an average of harvest years 2006-08 for England (unpublished data from BSFP 2006, 2007 & 2008).

	Winter wheat	Winter Barley	Spring Barley	Winter OSR
Ammonium Nitrate	60%	67%	56%	55%
Urea	15%	8%	8%	18%
Urea Ammonium Nitrate	17%	11%	10%	16%
Other	8%	14%	27%	11%

Table 3 Applications of organic manure to major arable crops by % crop area treated, reduction in manufactured N rate to treated area. All data is an average of harvest years 2006-08 for Great Britain (Defra, 2007; 2008; 2009).

	Winter wheat	Winter Barley	Spring Barley	Winter OSR
Crop area receiving organic manure	16%	17%	23%	12%
Reduction in manufactured N rate (kg N/ha)	26	25	7	20

Number of N splits

Of the four major crops considered, winter wheat receives the highest average number of nitrogen applications, at 2.66, with 50% of the wheat area receiving 3 applications (Table 4). Winter oilseed rape receives an average of 2.55 applications, with 2 being the most common number. The average numbers of applications for winter and spring barley are 1.96 and 1.56, respectively. For all four crops, there was a correlation between number of applications and overall application rate, with lower overall rates being applied in fewer splits. However the average rate at each application was generally greater where fewer splits were used, e.g. for winter wheat receiving a single application the average rate was 97 kg N/ha compared with an average of 68 kg N/ha for winter wheat receiving 3 applications. Winter oilseed rape had the highest N rate per split, with an average of 115 kg N/ha being applied in a single application and 182 kg N/ha over two splits. Individual splits were generally fairly even in size, apart from the 1st split when more than one application was made which was usually smaller than average (Tables 5-8).

Table 4 Number of N applications to major arable crops by percentage of crop area, and average overall N rates applied in different numbers of splits. All data is an average of harvest years 2006-08 for England (unpublished data from BSFP 2006, 2007 & 2008).

Number of N applications	Winter wheat		Winter Barley		Spring Barley		Winter OSR	
	% area	N rate	% area	N rate	% area	N rate	% area	N rate
0	2	0	3	0	5	0	1	0
1	5	97	14	84	42	94	4	115
2	33	169	69	118	49	140	47	182
3	50	203	14	148	4	169	38	209
4	10	237	1	*	1	182	10	222
5+	1	259	0	*	0	*	1	216
Average number of applications [†]	2.66		1.96		1.56		2.55	

[†] The calculation of the average number of applications assumes that crops receiving 5+ applications receive exactly 5 applications.

Table 5 Winter wheat: Average application rates by number of applications (unpublished data from BSFP 2006, 2007 & 2008).

Number of applications	<i>Average rate of each application (kg/ha)</i>					Overall
	1st	2nd	3rd	4th	5th	
1	97					97
2	74	94				169
3	55	81	67			203
4	47	66	75	50		237
5	44	50	74	58	33	259

Table 6 Winter oilseed rape: Average application rates by number of applications (unpublished data from BSFP 2006, 2007 & 2008).

Number of applications	<i>Average rate of each application (kg/ha)</i>					Overall
	1st	2nd	3rd	4th	5th	
1	115					115
2	81	101				182
3	50	73	86			209
4	36	55	67	64		222
5	36	39	39	52	50	216

Table 7 Winter barley: Average application rates by number of applications (unpublished data from BSFP 2006, 2007 & 2008).

Number of applications	<i>Average rate of each application (kg/ha)</i>				Overall
	1st	2nd	3rd	4th	
1	94				94
2	63	77			140
3	42	61	66		169
4	25	52	47	58	182

Table 8 Spring barley: Average application rates by number of applications (unpublished data from BSFP 2006, 2007 & 2008).

Number of applications	<i>Average rate of each application (kg/ha)</i>				Overall
	1st	2nd	3rd	4th	
1	84				84
2	56	62			118
3	53	42	53		148

Timing of N applications

For winter wheat, winter barley and spring barley, more than 90% of N is applied in March, April or May (Table 9). N is applied slightly earlier to winter oilseed rape, with 91% applied in February, March and April. For winter wheat, 25% of the total N was applied in March, 46% in April and 23% in May. For winter oilseed rape, 11% of the total N was applied in February, 44% in March and 36% in April. For winter barley, 40% of the total N was applied in March and 47% in April. For spring barley, 28% of the total N was applied in March, 51% in April and 16% in May.

Autumn applications are most common for oilseed rape, but even for this crop they have become less common over the last 25 years (Figure 2). In 2006-08, an average of 29% winter oilseed rape crops received an autumn N application in Great Britain at an average rate of 37 kg N/ha, similar to the 30 kg N/ha recommended for some crops by RB209. By

contrast in 1985, more than 80% winter oilseed rape crops received an autumn N application in England and Wales at an average rate of 52 kg N/ha.

Table 9 N application timings to major arable crops. All data is an average of harvest years 2006-08 for England (unpublished data from BSFP 2006, 2007 & 2008).

	Winter wheat		Winter Barley		Spring Barley		Winter OSR	
	% applic-ations	% N	% applic-ations	% N	% applic-ations	% N	% applic-ations	% N
August	0	0	1	0	0	0	2	1
September	0	0	1	0	0	0	6	3
October	0	0	0	0	0	0	2	1
November	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0
January	0	0	0	0	0	0	0	0
February	3	3	4	4	3	3	11	11
March	30	25	39	40	24	28	42	44
April	42	46	45	47	47	51	33	36
May	21	23	9	8	23	16	3	3
June	3	2	0	0	3	2	0	0
July	1	0	0	0	0	0	0	0

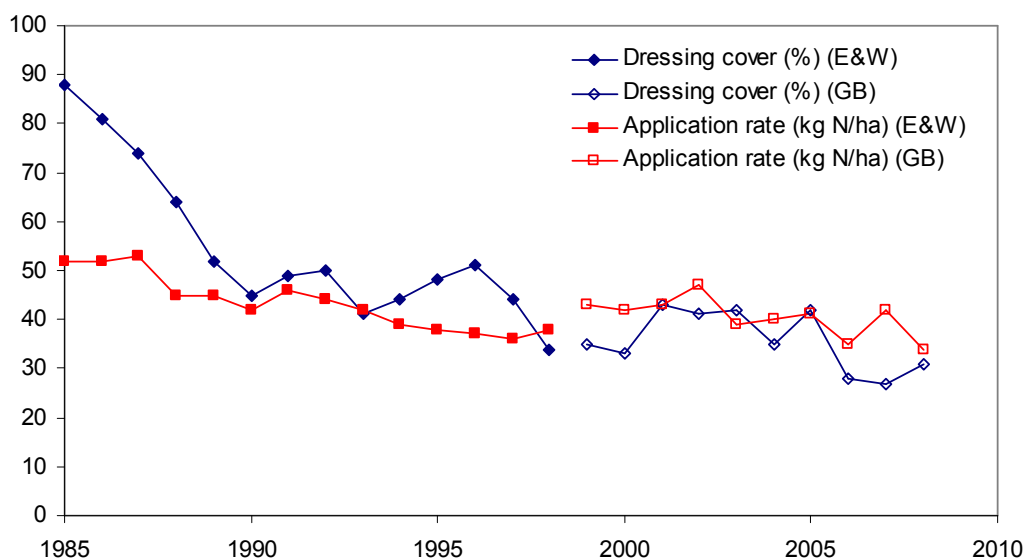


Figure 2 Percentage of winter oilseed rape area receiving N from August to January, and average application rate to those crops receiving a N application in this period. Data from 1985 to 1998 relates to England and Wales; data from 1999 to 2008 relates to Great Britain (Defra, 2009).

Winter wheat

There were no significant differences between the main fertiliser types (ammonium nitrate, Urea, Urea ammonium nitrate) regarding when they were applied. A greater proportion of the total N from compound fertiliser was applied early in March compared with other fertiliser types, much of which was likely to be ammonium sulphate (Table 10). The 1st application was applied in February or March in 77% of cases for wheat crops receiving the most common number of splits of three. 90% of the 2nd split was applied in March or April and 89% of the 3rd

splits were applied in April or May (Table 11). The 3rd and final split had been applied by the end of March on 4% of fields, by the end of April on 38% of fields and by the end of May on 93% of fields.

Table 10. Winter wheat: Summary of applications by month

	Per cent of applications	Per cent of Nitrogen from:				All
		Ammonium Nitrate	Urea	Urea Ammonium Nitrate	Other	
January	0%	0%	0%	0%	0%	0%
February	3%	3%	2%	1%	5%	3%
March	30%	24%	24%	25%	42%	25%
April	42%	47%	47%	46%	36%	46%
May	21%	24%	21%	26%	14%	23%
June	3%	2%	5%	2%	0%	2%
July	1%	0%	2%	0%	0%	0%
August	0%	0%	0%	0%	0%	0%
September	0%	1%	0%	0%	1%	0%
October	0%	0%	0%	0%	1%	0%
November	0%	0%	0%	0%	0%	0%
December	0%	0%	0%	0%	0%	0%
Total volume applied (over 3 years, '000 tonnes)		602	149	176	84	1,012
Per cent		60%	15%	17%	8%	100%

Table 11 Winter wheat: Timing and rate of applications by month, fields with three applications

Month	1st app		2nd app		3rd app	
	%	Avg rate	%	Avg rate	%	Avg rate
August	0%		0%		0%	
September	0%		0%		0%	
October	0%		0%		0%	
November	0%		0%		0%	
December	0%		0%		0%	
January	0%		0%		0%	
February	14%	53	3%	77	0%	
March	63%	55	22%	74	4%	97
April	12%	62	68%	79	34%	76
May	0%		6%	88	55%	66
June	0%		0%		6%	53
July	0%		0%		1%	43

Winter oilseed rape

There were no significant differences between the main fertiliser types (ammonium nitrate, Urea, Urea ammonium nitrate) regarding when they were applied (Table 12). The 1st application was applied in February or March in 90% of cases for oilseed rape crops receiving the most common number of splits of two. 95% of the 2nd split was applied in March or April (Table 13). The 2nd and final split had been applied by the end of March on 26% of fields and by the end of April on 96% of fields.

Table 12 Winter oilseed rape: Summary of applications by month

	Per cent of applications	Per cent of Nitrogen from:			Other	All
		Ammonium Nitrate	Urea	Urea Ammonium Nitrate		
January	0%	0%	0%	0%	0%	0%
February	11%	13%	6%	12%	12%	11%
March	42%	42%	50%	42%	49%	44%
April	33%	37%	40%	40%	21%	36%
May	3%	3%	2%	4%	2%	3%
June	0%	0%	1%	0%	0%	0%
July	0%	0%	0%	0%	1%	0%
August	2%	1%	0%	0%	3%	1%
September	6%	3%	0%	2%	10%	3%
October	2%	1%	0%	0%	2%	1%
November	0%	0%	0%	0%	1%	0%
December	0%	0%	0%	0%	0%	0%
Total volume applied (over 3 years, '000 tonnes)		176	56	50	36	318
Per cent		55%	18%	16%	11%	100%

Table 13 Winter oilseed rape: Timing and rate of applications by month, fields with two applications

Month	1st app		2nd app	
	%	Avg rate	%	Avg rate
August	0%		0%	
September	4%	55	0%	
October	0%		0%	
November	0%		0%	
December	0%		0%	
January	0%		0%	
February	20%	83	1%	
March	70%	83	25%	106
April	5%	82	70%	99
May	0%		4%	88
June	0%		0%	
July	0%		0%	

Winter barley

A greater proportion of the total Urea Ammonium Nitrate and compound fertiliser that was applied early in March compared with Ammonium Nitrate and Urea (Table 14). The 1st application was applied in March in 75% of cases for winter barley crops receiving the most common number of splits of two. The 2nd and final split had been applied by the end of March on 11% of fields and by the end of April on 86% of fields.

Table 14 Winter barley: Summary of applications by month

	Per cent of applications	Per cent of Nitrogen from:			Other	All
		Ammonium Nitrate	Urea	Urea Ammonium Nitrate		
January	0%	0%	0%	0%	0%	0%
February	4%	3%	2%	3%	6%	4%
March	39%	38%	38%	47%	50%	40%
April	45%	50%	51%	42%	34%	47%
May	9%	8%	7%	8%	7%	8%
June	0%	0%	0%	1%	0%	0%
July	0%	0%	0%	0%	0%	0%
August	1%	0%	0%	0%	0%	0%
September	1%	0%	0%	0%	2%	0%
October	0%	0%	0%	0%	1%	0%
November	0%	0%	1%	0%	0%	0%
December	0%	0%	0%	0%	0%	0%
Total volume applied (over 3 years, '000 tonnes)		105	13	16	21	156
Per cent		67%	8%	11%	14%	100%

Table 15 Winter barley: Timing and rate of applications by month, fields with two applications

Month	1st app		2nd app	
	%	Avg rate	%	Avg rate
August	0%		0%	
September	1%		0%	
October	0%		0%	
November	0%		0%	
December	0%		0%	
January	0%		0%	
February	11%	52	0%	
March	72%	63	11%	75
April	16%	69	75%	78
May	1%		13%	77
June	0%		0%	
July	0%		0%	

Spring barley

There were no significant differences between the main fertiliser types (ammonium nitrate, Urea, Urea ammonium nitrate) regarding when they were applied. (Table 16). The 1st application was applied in February or March in 85% of cases for wheat crops receiving the most common number of splits of two. 87% of the 2nd split was applied in March or April (Table 17). The 2nd and final split had been applied by the end of March on 9% of fields, by the end of April on 61% of fields and by the end of May on 96% of fields. For crops receiving one split 21% of fields received the N in March and 76% had received the N by the end of April (Table 18)

Table 16 Spring barley: Summary of applications by month

	Per cent of applications	Per cent of Nitrogen from:			Other	All
		Ammonium Nitrate	Urea	Urea Ammonium Nitrate		
January	0%	0%	0%	0%	1%	0%
February	3%	1%	2%	6%	7%	3%
March	24%	24%	26%	34%	33%	28%
April	47%	54%	56%	49%	44%	51%
May	23%	18%	15%	10%	14%	16%
June	3%	2%	1%	2%	1%	2%
July	0%	0%	0%	0%	0%	0%
August	0%	0%	0%	0%	0%	0%
September	0%	0%	0%	0%	0%	0%
October	0%	0%	0%	0%	0%	0%
November	0%	0%	0%	0%	0%	0%
December	0%	0%	0%	0%	0%	0%
Total volume applied (over 3 years, '000 tonnes)		46	6	8	22	82
Per cent		56%	8%	10%	27%	100%

Table 17 Spring barley: Timing and rate of applications by month, fields with two applications

Month	1st app		2nd app	
	%	Avg rate	%	Avg rate
February	7%	44	0%	43
March	45%	55	9%	72
April	40%	58	52%	64
May	8%	70	35%	55
June	1%		5%	57
July	0%		0%	

Table 18 Spring barley: Timing and rate of applications by month, fields with one application

Month	1st app	
	%	Avg rate
February	2%	112
March	19%	83
April	55%	84
May	23%	81
June	2%	81
July	0%	